

课程编号:99901815

课程名称:无线通信前沿技术（全英文）

Wireless Communication: Principles and Emerging Technologies

1. 课堂讲授学时 **Lecture Hours:** 32
2. 课堂实验学时 **Laboratory Hours:** 0
3. 课下研讨学时 **Colloquia Hours:** 0
4. 学生课下投入学时 **Individual Study Hours:** 16
5. 学分 **Credits:** 2
6. 开课学年学期（如果有强制性的要求则必须填，否则可以不填） **Occurrence:** **Summer Course, 2nd year, 3rd year, 4th year**
7. 先修课程 **Prerequisite(s):** 必须先修的课程直接写课程编号和课程名称，建议先修的课程在课程名称后用*号标注，并在下一行注明：
* Principles of Communication, *Computer Principles

8. 课程概要 **Course Description:** 100 字以内，学习内容以学术关键词出现。
This course expounds fundamental principles and emerging technologies of wireless communication systems. It covers wireless communication basics, 5G access and core network key technologies, IoT communication solutions including NB_IoT and LoRa, 6G development trends and AI_wireless communication integration. Adopting theoretical lectures, group presentations and instructor comments, it assesses students via programming practice, presentations and project reports. Students completing this course will grasp core technical systems and academic norms to design and implement wireless communication application and research projects.
9. 课程预期学习成果 **Course Outcomes:** 用数字 1 到 9 列出每一项主要学习成果
By the end of successful completion of this course, the student will be able to:

(1) Master the basic architecture, transmission principles and development context of wireless communication systems.

- (2) Understand key 5G technologies including Massive MIMO, channel coding, network slicing and resource scheduling.
- (3) Recognize 6G technology trends and the integrated application of AI in wireless communication.
- (4) Complete group projects, master academic writing, presentation skills and research norms in wireless communication.

10. 教学内容与学时分配 **Course Content, Laboratories and Laboratory Hours** (有则填, 没有则不填), **Colloquia Hours** (有则填, 没有则不填): 各章节目录与学时, 实验内容与学时, 研讨内容与学时

(1) **Foundations of Wireless Communication (2 class hours)**

- Evolution of wireless systems (1G → 6G)
- Wireless communication system architecture
- Frequency spectrum, regulation, and standards
- Basic signal propagation concepts

(2) **Radio Propagation and Channel Modelling (2 class hours)**

- Path loss, shadowing, and fading (small-scale & large-scale)
- Multipath propagation and Doppler effects
- Channel models (AWGN, Rayleigh, Rician)
- Channel measurement and modelling techniques

(3) **Digital Communication Fundamentals (4 class hours)**

- Modulation schemes (BPSK, QPSK, QAM, OFDM)
- Source and channel coding
- Error control techniques (ARQ, FEC)
- Link budget analysis

(4) **Multiple Access and Resource Allocation (4 class hours)**

- FDMA, TDMA, CDMA, OFDMA, NOMA
- Scheduling and radio resource management
- Interference management techniques
- Spectrum sharing and efficiency

(5) **MIMO and Advanced PHY Techniques (4 class hours)**

- MIMO systems (spatial multiplexing, diversity)
- Beamforming and massive MIMO
- Cooperative and distributed MIMO (e.g. cell-free systems)
- Diversity techniques

(6) **Wireless Network Architectures (4 class hours)**

- Cellular networks (4G LTE, 5G NR architecture)
- Small cells and heterogeneous networks (HetNets)
- Cloud/virtualised RAN and O-RAN
- Core network concepts and network slicing

(7) **Emerging Technologies in Wireless Communications (4 class hours)**

- 5G advanced and beyond (towards 6G)
- AI/ML for wireless networks (self-optimization, automation)
- Integrated Sensing and Communication (ISAC)
- Terahertz and mmWave communications
- Reconfigurable Intelligent Surfaces (RIS)

(8) **Applications and Use Cases (4 class hours)**

- Smart cities and intelligent transport systems
- Autonomous systems and robotics
- Public safety and mission-critical communications
- Industrial automation and digital twins

(9) **Future Directions and Research Challenges (4 class hours)**

- 6G vision and key drivers
- Sustainability and green communications
- Spectrum scarcity and new paradigms
- Open research problems and innovation opportunities

11. 考核与成绩评定 Grading:

Course Presentation (40%)

Evaluate group collaboration, logical expression, technology understanding, and response to teacher comments.

Project Report (60%)

Judge project design integrity, academic writing norms, citation standards, and comprehensive research summary.

12. 教材，参考书 Text & Reference Book:

Author: Theodore S. Rappaport

Title: Wireless Communications: Principles and Practice

Edition: 2nd Edition

Year: 2002

ISBN: 978-0130422323

13. 编写教师 **Course Lecturer:** Kanapathippillai Cumanan, Professor of Wireless Communications, University of York, UK.

编写教师 **Course Lecturer** (签字 **Signature**):
